



CHAPTER 7: Traffic Calming

CHAPTER 7: TRAFFIC CALMING

Traffic calming refers to a number of methods used to reduce vehicle speeds, improve safety, and enhance the quality of life. In the simplest definition, it is changing the physical environment to reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for pedestrians and other non-motorized street users. Recognizing the role that traffic calming may be able to play in addressing neighborhood and regional traffic concerns. This technical memorandum serves to delineate a process by which a traffic calming program can be carried out, as well as going further to discuss different traffic calming measures and their applicability to the Whitefish area.

The overriding goals of traffic calming are to:

- Improve the quality of life in an area;
- Address the wishes and needs of the people living in or using an area for purposes other than motorized transit;
- Create safe, attractive streets;
- Help to reduce the negative effects of motor vehicles on an area such as pollution and sprawl; and
- Promote pedestrian, cycle and transit use.

To that end, the following objectives are identified to assist in meeting the stated goals:

- Achieve slow speeds for motor vehicles;
- Reduce collision frequency and severity;
- Increase the safety, and the perception of safety, for non-motorized users of the street(s);
- Reduce the need for police traffic enforcement;
- Enhance the attractiveness of the street environment (street scaping);
- Encourage water absorption into the ground;
- Increase access for all modes of transportation; and
- Reduce cut-through motor vehicle traffic.

Traffic calming techniques cannot be used with the same degree of success on all roadway facilities. Traffic calming is rarely seen on roadway facilities higher than a collector roadway functional classification. This is primarily due to roadways functionally classified higher than a collector having the primary purpose of moving traffic, whereas for collector and local roadways the primary purpose tends to shift more towards serving adjacent land uses and infiltration into neighborhoods. In some circumstances, traffic calming can be applied to a minor arterial roadway with low traffic volumes.

7.1 PURPOSE OF TRAFFIC CALMING

Traffic calming is comprised of the three “E’s,” Education, Enforcement and Engineering. The Institute of Transportation Engineers (ITE) defines traffic calming as a “combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users.” It is used on local streets

to discourage non-local traffic. Non-local traffic is not invested in the neighborhood, and therefore has less respect for speed limits, and the non-vehicular elements of the street environment. Certain, limited traffic calming measures are appropriate for slowing traffic on collectors or minor arterials as well.

Because traffic calming includes an educational or enforcement campaign, or an engineering study, it can result in the physical construction of traffic elements designed to reinforce the perceived need for caution by the users of the transportation system. The need for physical traffic calming devices indicates the transportation user's consistent failure to appropriately interact with the surroundings. Regardless of any traffic calming measures installed, the primary responsibility for safe use of the streets lies with the individual driver, cyclist, or pedestrian.

The success of traffic calming measures on a local street depends upon strong support by residents in the immediate area. Additionally, the traffic calming measures need to address situations that a number of residents agree should be addressed. Situations that many people agree exist and that could respond to traffic calming techniques will have more support from the neighborhood, and will better enhance the neighborhood environment. Traffic calming projects which involve installing "hard" improvements should meet several criteria before being considered for implementation, because they can be disruptive to the residents in the surrounding area, difficult to fund and maintain, and difficult to remove once installed.

Traffic calming is a series of techniques designed to lower vehicle speeds, reduce the amount of cut-through or non-local traffic, and in certain cases, decrease truck traffic. The goal of these techniques is to keep traffic on a local street local. Other goals which traffic calming can achieve include the following:

- Reduce air and noise pollution caused by vehicles;
- Reduce the frequency and severity of accidents;
- Improve the street environment through increased landscaping;
- Improve the quality of life for residents;
- Promote walking and bicycling;
- Reduce the need for police enforcement;
- Address speeding or other problems on collectors or minor arterials; and
- Improve pedestrian safety.

Traffic calming elements can be incorporated into the initial design of subdivision, or can be retrofitted into existing subdivisions. The City of Whitefish has many streets which already contain Traffic calming measures. These include on-street parking, and sidewalks separated from the street by a planting strip. Other techniques can include landscaped medians, pedestrian bulb-outs at corners, traffic circles or other intersection design techniques as well as other mid-block design techniques.

There are however, several circumstances where traffic calming becomes necessary. One of the most common circumstances is when the arterial system is congested or has turn restrictions. This set of circumstances will lead to arterial traffic detouring into an adjacent neighborhood. Local streets near a heavily used arterial can experience arterial traffic.

During street construction traffic calming issues may be raised. Detours are necessary but frustrating for residents. However, when motorists use alternate routes instead of the designated detours, concerns with congestion, speed, pollution and enforcement become real. But these issues are temporary, and temporary measures are appropriate to address them. Some examples of temporary traffic calming measures includes:

- Removable median curbs to constrict, or choke, a roadway;
- Removable median curbs placed to form a traffic circle within an intersection;
- Removable median curb placed to form forced turn diverters;
- Temporary bollards to close off traffic to a roadway; and
- Temporary speed bumps.

Very few traffic calming techniques are appropriate for use on arterials, because they interfere with an arterial's ability to move people and vehicles quickly from one place to another. The techniques which are appropriate for the arterial system are summarized later in this technical memorandum.

7.2 HISTORY OF TRAFFIC CALMING

Traffic calming techniques originated in Germany in the 1960's with the "pedestrianization" of downtown shopping areas. This idea expanded to the Netherlands in the 1970's where the concept was applied to residential streets to better integrate motorized and non-motorized traffic. The Dutch believed the street served as an extension of the residents' yard. This philosophy resulted in giving pedestrians priority over automobiles. Based on this philosophy, the Dutch installed obstacles, bends, and bottlenecks at regular intervals to prevent vehicular traffic from moving at speeds higher than pedestrians could walk. Germany developed the more modern concept of area-wide traffic calming, which considers the entire road system in order to avoid merely shifting one problem to another location.

Over the past 30 years, traffic calming techniques have expanded throughout the globe, including Japan, Australia, and in North America. In Montana, the cities of Missoula and Bozeman both have formal traffic calming programs. These two programs are substantially different, but each community is satisfied with their program. In the Northwest, traffic calming techniques have been adopted in most of the larger cities, with active programs in Seattle and Bellevue, WA, and Portland and Eugene, OR.

In Missoula, and most of these Northwest communities, the concept of area-wide traffic calming has been adopted, with the emphasis on improving neighborhood street systems rather than alleviating a problem at a specific location. Due to this philosophy, these traffic-calming programs are known as Local Area Traffic Management Programs, Neighborhood Traffic Management Programs, Neighborhood Traffic Control Programs, or something similar.

7.3 TYPES OF TRAFFIC CALMING MEASURES

Traffic calming measures generally fit into one of the following six categories:

1. Passive measures
2. Education and enforcement
3. Signing and pavement marking
4. Vertical deflection
5. Horizontal deflection
6. Obstruction

7.3.1 *Passive Measures*

Passive measures are described as measures which are built into the street environment. They are not immediately obvious to the traveling public, but nevertheless produce a calming effect on traffic. Some of these measures are listed below.

- Tree-lined streets;
- Streets with boulevards separating the sidewalks;
- Streets with raised center medians (usually landscaped);
- On-street parking (including angled parking);
- Highly visible pedestrian crossings; and
- Short building set-back distances.

These elements tend to slow traffic by giving motorists the impression that the street is narrow and that extra care is required, but these elements do not restrict or interfere with traffic flow. A combination of more than one of these techniques, or these techniques combined with measures from the other categories, will produce better results.

7.3.2 *Education and Enforcement*

Several techniques are available to raise public awareness of traffic problems and change the behaviors contributing to problems. Some of these techniques are listed below.

- Neighborhood Speed Watch Program - A speed monitoring program where residents themselves measure vehicle speeds with a radar unit and record license plate numbers of speeding vehicles. Follow-up action of the data can include sending letters to the registered owners of the vehicles explaining the safety concerns within the neighborhood and requesting better observance of the speed limits.
- Radar Speed Monitoring Trailer - A pull-behind trailer equipped with speed detection equipment, a readout of vehicle speeds, and a sign with the posted speed limit is brought to an area with speeding problems. These trailers are usually unmanned; however better results are obtained if someone is present. Additionally, the trailer can be equipped with a camera that would record license plate information for possible follow-up.

- Neighborhood Traffic Safety Campaign - As a part of the normal neighborhood group activities, newsletters or other materials can be produced containing educational information regarding traffic issues. These materials can be tailored to issues of specific concern to different neighborhoods. These issues can then be addressed at regularly scheduled meetings or at special meetings and recommendations can be put forward to increase neighborhood traffic safety.
- Target Enforcement - This is a requested, time-limited addition of police enforcement within a neighborhood.
- Public Service Announcements (PSA's) - Video public service announcements on traffic issues, mainly related to safety, can be produced. These can include traffic calming information, and should be televised during local news programs, to inform the public on traffic issues and calming techniques identified in this technical memorandum.

7.3.3 Signage and Pavement Marking

Traffic control signs and pavement markings can be installed as non-intrusive traffic calming measures. These techniques are already in use in the Whitefish area. The signs can include speed limit signs, dead-end street signs, and signs indicating school crossings or general pedestrian crossing. Pavement markings can include marked crosswalks, delineation of (narrow) lanes, and speed limit markings. Traffic calming techniques which specifically fall in this category include:

- Truck Route Signing – Signs placed on routes where trucks are allowed, plus signs placed on routes where trucks are not allowed.
- Basket Weave Stop Sign Pattern – Stop signs placed at every intersection in a residential neighborhood with stops alternating between east west and north south. Note: this is appropriate for local access streets only, and it disregards MUTCD warrants.
- Additional speed limit signs.
- Edge Lines – Painted lines on the pavement which narrow traffic lanes and/or provide for bicycle lanes or on-street parking.
- Stop Bars – painted lines on the pavement that show motorists where to stop for stop signs.

7.3.4 Vertical Deflection, Horizontal Deflection, and Obstruction

There is a wide variety of physical traffic calming measures which fall under the categories of vertical deflection, horizontal deflection and installation of obstructions. Each measure has both advantages and disadvantages. A comprehensive description of a wide variety of these measures is presented on the tables at the end of this technical memorandum. These tables include a general cost for basic installation of each measure. Actual costs may increase, depending upon such additions as irrigation systems, street lighting, landscaping, installation of decorative brick pavers, etc. Acquisition of additional right-of-way can also raise the cost, sometimes dramatically so.

Several guidelines should be considered when deciding to implement these types of deflection and obstruction measures. These include:

- Attempt less restrictive measures before considering more restrictive measures such as road closures or other route modifications.
- Space devices 300-to-500 feet apart in order to contain speeds to a 20-to-25 mile-per-hour speed range.
- Make accommodations for drainage and snow removal.
- Make accommodations for emergency vehicles.
- Consider pedestrian and bicyclist needs.
- Address landscaping or other maintenance issues.

7.4 TRAFFIC CALMING PROGRAM SUMMARY

Many traffic calming programs are in place in the United States. The best programs provide a balance of citizen input and economic realities, and are standardized for fair treatment of all residents. These programs ensure that the traffic calming techniques proposed are necessary, attractive, effective, and safe, and are implemented at a minimal cost to the general public. The programs also provide citizens a regular and on-going opportunity to nominate, test, and implement improvements to address problems with the local street network in a timely, orderly, and efficient manner.

The City of Whitefish would like to implement such a program. A proposed traffic calming program should be broken down into three phases, each with multiple steps. Together they are designed to ensure that the physical construction is done only when truly necessary, and only when lesser measures have been tried first. Each phase would require the participation of neighborhood residents and the Public Works Department. The program's priority is the safe use of the streets for all users, be they vehicular, cyclist, or pedestrian.

For purposes of this discussion, the agency with jurisdiction will be the City of Whitefish. However, this does not preclude any similar program that may be implemented by Flathead County. Therefore, during the following discussion, the use of the term “the City” refers to whatever jurisdiction ultimately implements this procedure.

7.5 TRAFFIC CALMING TECHNIQUES APPLICABLE TO COLLECTORS AND MINOR ARTERIALS

A few of the measures depicted on the tables on the following pages are applicable to non-local street conditions. Installation of any of these measures will be done at the discretion of City staff. These measures do not fall under the process outlined previously. The measures are restricted to horizontal deflection and include the following:

- Mid-block median;
- Curb bulb outs / neckdown; and
- On-street parking.

These measures can be used to slow traffic where chronic speeding problems have been shown to exist, or to accommodate pedestrian traffic. The mid-block median usually is present on arterials due to another piece of infrastructure, such as a railroad track which passes over the street, or an overhead pedestrian crossing structure.

On-street parking almost always occurs in a residential area, but also can occur in retail or industrial sectors. Judicious use of on-street parking can influence the traffic flow and help regulate traffic speeds on collectors or minor arterials. Bulb outs, also called neckdowns, can be used to create the illusion for the driver that the roadway is narrowing. This perception will cause the driver to slow down. A secondary benefit of the bulb outs is the decreased walking distance for pedestrians at the crosswalks. Bulb outs generally are wide enough for a car to park in their “shadow”. This generally creates good separation between the parked cars and the moving traffic.

7.6 TRAFFIC CALMING NEEDS IN WHITEFISH

During the development of this Transportation Plan, several specific areas were identified for potential traffic calming measures. Again, traffic calming is generally in response to something that isn’t quite working as intended. The City does occasionally receive complaints from its citizens regarding the need for traffic calming.

Issue 1

Speeding and safety is a concern through many of the neighborhoods near the High School and the Muldown Elementary School.

Although there are recommendations for additional road connections in this area, traffic calming in the existing neighborhood may be feasible. Typically, traffic calming features adjacent to school neighborhoods usually include a mixture of traffic circles, raised intersection tables, and/or curb bulb-outs to neck-down the travel lane width at neighborhood intersections. These should all be explored with neighborhood representatives before implementation. It should be recognized that these types of features can reduce emergency service response time, hamper snow removal activities and/or result in the loss of on-street parking adjacent to the intersections.

Issue 2

Speeding and safety along Wisconsin Avenue

Chapter 8 contains several short range and long-range recommendations for the Wisconsin Avenue corridor. As a major arterial, traffic calming typically is not applied to this type of facility. Potential traffic calming remedies could, however, include features that change the perception of the driving environment. This would include landscaping and features to affect the streetscape along the sides of the road (street trees, etc.) and/or narrow median islands within the roadway itself. Any type of traffic calming along this facility would be met with modest improvement to the issues more fully identified in **chapter 8**.

*Issue 3**Safety & speeding issues around the schools*

Chapter 6 and chapter 8 provide mechanisms to temper some of the school related issues. Again, traffic calming in the existing neighborhoods around the schools may be feasible. Typically, traffic calming features adjacent to school neighborhoods usually include a mixture of traffic circles, raised intersection tables, and/or curb bulb-outs to neck-down the travel lane width at neighborhood intersections. These should all be explored with neighborhood representatives before implementation.

*Issue 4**More crossing guards are needed around the schools*

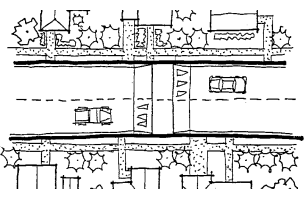
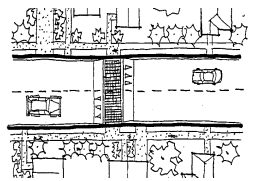
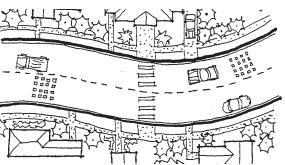
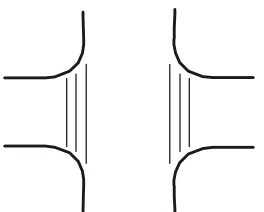
Although this is not necessarily a “traffic calming” feature, the concept of additional crossing guards is generally accepted as desirable by most citizens. Implementation hurdles are realized, though, based on lack of financial resources. Although a volunteer crossing guard program could be explored in the future, there are issues with volunteers not showing up (for example when ill) and not having a formal back-up process in place.

*Issue 5**Citizens need a point of contact to explore traffic calming*

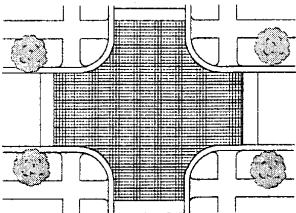
As a matter of practice, all requests and/or complaints should be directed to the Public Works Department for consideration. The potential examples and remedies contained in this chapter via **Table 7-1** can be examined and applied by city engineering staff as appropriate.

Table 7-1 Types of Traffic Calming Measures

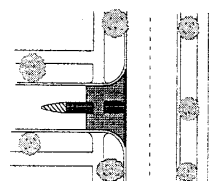
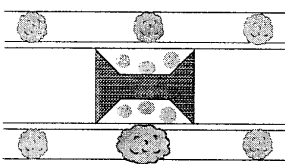
Vertical Deflection

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 Speed Hump	Paved hump in the street that causes discomfort at high speeds. <ul style="list-style-type: none"> • Speed reduction • Possible traffic reduction 	<ul style="list-style-type: none"> • Effective if used in series at 300 to 500 foot spacing. • Self-enforcing. • Relatively inexpensive. 	<ul style="list-style-type: none"> • If not properly designed, drivers may skirt around to reduce impact. • Drivers may speed up between humps. • May increase volumes on other streets. • Difficult to properly construct. 	<ul style="list-style-type: none"> • Emergency vehicles • Drainage • Signage • Snow removal Estimated Cost Range = \$1,000 to \$2,000
 Raised Crosswalk	Speed hump designed as a pedestrian crossing. <ul style="list-style-type: none"> • Speed reduction at crossing • Possible traffic reduction 	<ul style="list-style-type: none"> • Highlights crosswalk. • Excellent pedestrian safe treatment. • Aesthetically pleasing if designed. • Relatively inexpensive. 	<ul style="list-style-type: none"> • Drivers may speed up between humps. • May increase volumes on other streets. • Difficult to properly construct. 	<ul style="list-style-type: none"> • Emergency vehicles • Drainage • Signage • Snow removal Estimated Cost Range = \$1,000 to \$2,000
 Rumble Strips	Patterned sections of rough pavement. <ul style="list-style-type: none"> • Possible speed reduction 	<ul style="list-style-type: none"> • Relatively inexpensive to install. • Create driver awareness. 	<ul style="list-style-type: none"> • High maintenance. • May adversely impact bicyclists. • Noisy by design, and not recommended for all areas. 	<ul style="list-style-type: none"> • Emergency vehicles Estimated Cost Range = \$1,000 to \$2,000
 Surface Valley Gutters	Dips in the street that can be used to carry run-off as well as cause discomfort to drivers at high speeds. <ul style="list-style-type: none"> • Speed reduction • Possible traffic reduction 	<ul style="list-style-type: none"> • Effective if used in series at 300 to 500 foot spacing. • Self-enforcing. • Relatively inexpensive during initial construction. 	<ul style="list-style-type: none"> • Drivers may speed up between dips. • May increase volumes on other streets. • Not usually appropriate for existing streets with established drainage patterns. 	<ul style="list-style-type: none"> • Emergency vehicles • Drainage • Signage Estimated Cost Range = \$1,000 to \$2,000

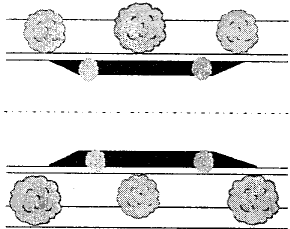
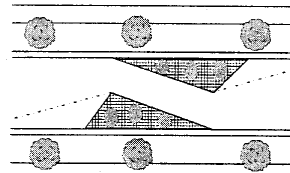
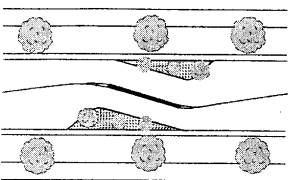
Vertical Deflection

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Raised Intersection</p>	<p>Raised plateau where streets intersect.</p> <ul style="list-style-type: none"> • Speed reduction • Possible traffic reduction 	<ul style="list-style-type: none"> • Slows vehicles in the most critical area, reducing conflict. • Highlights intersection. • Excellent pedestrian safety treatment. • Aesthetically pleasing if well designed. • Better for emergency vehicles than speed humps. 	<ul style="list-style-type: none"> • Increases difficulty of making a turn. • Increased maintenance. • Requires adequate signage and driver education. 	<ul style="list-style-type: none"> • Emergency vehicles • Drainage • Signage • Snow removal <p>Estimated Cost Range = \$4,000 to \$6,000</p>

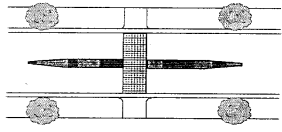
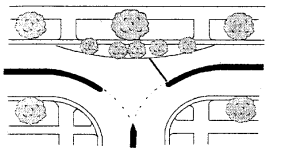
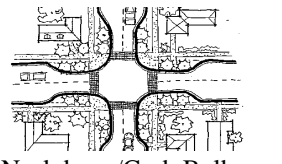
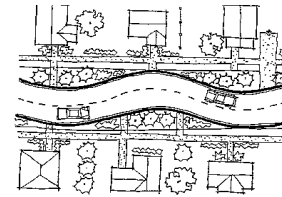
Horizontal Deflection

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Gateway Treatment</p>	<p>Entry treatment that communicates a sense of neighborhood identity and a change in traffic conditions.</p> <ul style="list-style-type: none"> • Speed reduction at entry • Traffic reduction 	<ul style="list-style-type: none"> • Positive indication of a change in environment from arterial road to residential street. • Reduces pedestrian crossing distances. • On wide streets, provides space for landscaping in the median. 	<ul style="list-style-type: none"> • Low speed of turning vehicles may restrict flow on adjacent arterial. 	<ul style="list-style-type: none"> • Emergency vehicle access • Lighting • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$5,000 to \$25,000</p>
<p>Single-Lane Slow Point/ Lane Narrowing</p>  <p>Lane Narrowing</p>	<p>Mid-block expansion of landscaped areas and/or on-street parking in order to physically narrow the street to a single traffic lane.</p> <ul style="list-style-type: none"> • Speed Reduction • Traffic Reduction 	<ul style="list-style-type: none"> • Minor inconvenience to drivers. • Minimal inconvenience to local traffic. • Shorter crossing distance for pedestrians. • Provides space for landscaping. • Effective when used in series. 	<ul style="list-style-type: none"> • Unfriendly to bicyclists unless designed to accommodate them. • Conflict between opposing drivers arriving simultaneously could create problems. • Contrary to driver expectation of unobstructed flow. 	<ul style="list-style-type: none"> • Emergency vehicle access • Lighting • Signage • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$8,000 to \$20,000</p>

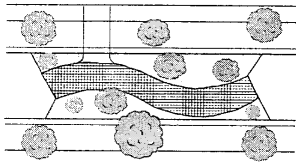
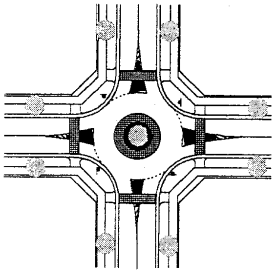
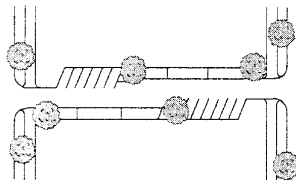
Horizontal Deflection

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Two-Lane Slow Point</p>	<p>Mid-block expansion of landscaped areas and/or on-street parking in order to physically narrow the street.</p> <ul style="list-style-type: none"> • Speed reduction • Possible traffic reduction 	<ul style="list-style-type: none"> • Minor inconvenience to drivers. • Regulates parking if bulb-outs are placed in no parking zones. • Protects parked vehicles. • Reduces pedestrian crossing distance. • Provides space for landscaping. 	<ul style="list-style-type: none"> • Less effective in reducing speed and diverting traffic than the single-lane application. • Unfriendly to bicyclists unless designed to accommodate them. 	<ul style="list-style-type: none"> • Lighting • Signage • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$8,000 to \$20,000</p>
 <p>Single-Lane Angled Slow Point</p>	<p>Offset curb extensions used to narrow the street to a single lane and create angled deviations in the path of travel.</p> <ul style="list-style-type: none"> • Speed reduction • Traffic reduction 	<ul style="list-style-type: none"> • Minor inconvenience to drivers. • Minimal inconvenience to local traffic. • Shorter crossing distance for pedestrians. • Provides space for landscaping. • Effective when used in series. 	<ul style="list-style-type: none"> • Unfriendly to bicyclists unless designed to accommodate them. • Conflict between opposing drivers arriving simultaneously could create problems. • Contrary to driver expectation of unobstructed flow. 	<ul style="list-style-type: none"> • Emergency vehicle access • Lighting • Signage • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$8,000 to \$20,000</p>
 <p>Two-Lane Angled Slow Point</p>	<p>Offset curb extensions used to narrow the street and create angled deviations in the path of travel.</p> <ul style="list-style-type: none"> • Speed reduction • Possible traffic reduction 	<ul style="list-style-type: none"> • Same as Single-Lane Angled Slow Point, except pedestrian safety is reduced. 	<ul style="list-style-type: none"> • Same as Single-Lane Angled Slow Point, except less effective in controlling speeds because drivers can create a straighter through movement by driving over centerline. 	<ul style="list-style-type: none"> • Lighting • Signage • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$8,000 to \$20,000</p>

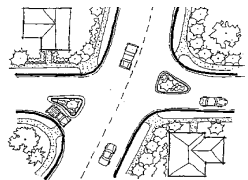
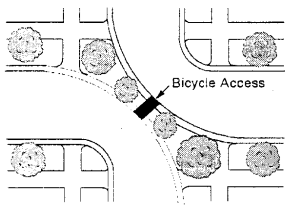
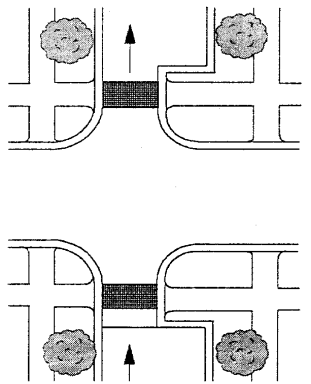
Horizontal Deflection

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Mid-Block Median</p>	<p>Island or barrier in the center of a street that narrows lanes and segregates traffic.</p> <ul style="list-style-type: none"> Possible speed reduction Possible traffic reduction 	<ul style="list-style-type: none"> Provides a refuge for pedestrians and bicyclists. Can improve the streetscape if landscaped. 	<ul style="list-style-type: none"> Limited reduction in vehicle speeds. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$5,000 to \$10,000</p>
 <p>Modified "T" Intersection</p>	<p>Modification of "T" intersection layout which gives priority to turning traffic.</p> <ul style="list-style-type: none"> Speed reduction Possible traffic reduction 	<ul style="list-style-type: none"> Reduces through traffic along the top of the "T". May provide space for landscaping. 	<ul style="list-style-type: none"> Can cause confusion regarding priority movements, which may lead to accidents. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$5,000 to \$10,000</p>
 <p>Neckdown/Curb Bulbs</p>	<p>Physical curb reduction of road width at an intersection.</p> <ul style="list-style-type: none"> Speed reduction 	<ul style="list-style-type: none"> Reduces pedestrian crossing distance. Can be used in multiple applications or on a single segment of roadway. Aesthetically pleasing if landscaped. 	<ul style="list-style-type: none"> Unfriendly to bicyclists unless designed to accommodate them. Landscaping may cause sight line problems. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$20,000 to \$30,000</p>
 <p>Deviation/Chicanes</p>	<p>Offset curb extensions that cause deviation in the path of travel.</p> <ul style="list-style-type: none"> Speed reduction Possible traffic reduction 	<ul style="list-style-type: none"> Imposes minimal inconvenience on local traffic. Reduces pedestrian crossing distance. Provides large area for landscaping. Reduces speed without significantly increasing emergency response time. Aesthetically pleasing. 	<ul style="list-style-type: none"> May create opportunities for head-on conflicts on narrow streets. Cost is greater than many other devices. Unfriendly to bicyclists unless designed to accommodate them. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$20,000 to \$30,000</p>

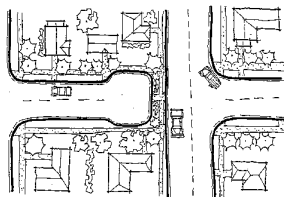
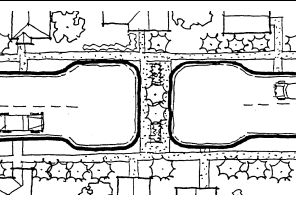
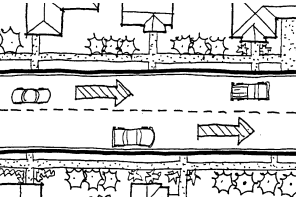
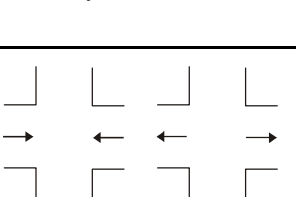
Horizontal Deflection

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Driveway Link</p>	<p>Narrow winding driveway section placed between two standard street segments.</p> <ul style="list-style-type: none"> • Speed reduction • Traffic reduction 	<ul style="list-style-type: none"> • Changes the initial impression of the street. Appears to be a road closure yet allows through movements for local traffic. • Provides a large area for landscaping. 	<ul style="list-style-type: none"> • High cost can be prohibitive. Best installed in conjunction with street reconstruction or initial construction. • Unfriendly to bicyclists unless designed to accommodate them. 	<ul style="list-style-type: none"> • Emergency vehicle access • Lighting • Signage • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$20,000 to \$50,000</p>
 <p>Traffic Circle/Roundabout</p>	<p>Raised circular area placed in the center of an intersection. Drivers travel in a counter-clockwise direction and are required to yield upon entry.</p> <ul style="list-style-type: none"> • Speed reduction at intersection • Possible traffic reduction 	<ul style="list-style-type: none"> • Reduces accidents by 50% to 90% over stop control. • Provides space for landscaping. • Cheaper to maintain than signals. • Effective at multi-leg intersections. • Provides equal access to intersections for all drivers. • Provides a good environment for bicyclists. 	<ul style="list-style-type: none"> • May be restrictive for larger vehicles if designed to a low speed. (This can be minimized by the use of a mountable apron.) • Right of way may need to be purchased to accommodate left turns by large vehicles. • Initial safety issues as drivers adjust. • May increase volumes on adjacent streets. 	<ul style="list-style-type: none"> • Lighting • Signage • Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$10,000 to \$50,000</p>
 <p>Shared Zone</p>	<p>A block with narrow entry points and high-density parking which functions similarly to a parking lot.</p> <ul style="list-style-type: none"> • Speed reduction • Traffic reduction 	<ul style="list-style-type: none"> • Provides a low speed shared environment that is safe for all users. • Improves amenity without restricting access. • Provides flexibility for on-street parking. 	<ul style="list-style-type: none"> • High cost unless part of original design. • May result in an increased number of low speed accidents. 	<ul style="list-style-type: none"> • Emergency vehicle access • Signage <p>Estimated Cost Range = \$15,000 to \$25,000</p>

Obstruction

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Forced Turn Barriers/ Diverters</p>	<p>Small traffic islands installed at intersections to restrict and channelize turning movements.</p> <ul style="list-style-type: none"> Traffic reduction Possible speed reduction 	<ul style="list-style-type: none"> Changes driving patterns May reduce cut through traffic. May be attractive if landscaped. 	<ul style="list-style-type: none"> May increase trip length for some drivers. May increase response times for emergency vehicles. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$4,000 to \$8,000</p>
 <p>Diagonal Road Closure</p>	<p>Barrier placed diagonally across a four-legged intersection, interrupting traffic flow across the intersection.</p> <ul style="list-style-type: none"> Traffic reduction Speed reduction 	<ul style="list-style-type: none"> Eliminates through traffic Provides area for landscaping. Reduces traffic conflict points. Increases pedestrian safety Can include bicycle path connection. 	<ul style="list-style-type: none"> May inconvenience residents gaining access to their properties. May inhibit access by emergency vehicles. May divert through traffic to other local streets. Altered traffic patterns may increase trip length. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$10,000 to \$20,000</p>
 <p>Partial Street Closure</p>	<p>Blockage of one direction of traffic on a two-way street. The open lane of traffic is signed one-way, and traffic from the blocked lane is not allowed to drive around the barrier in the open lane.</p> <ul style="list-style-type: none"> Traffic reduction Speed reduction 	<ul style="list-style-type: none"> Reduces through traffic in one direction. Allows two-way traffic on the remainder of the street. Shorter crossing distance for pedestrians. Provides space for landscaping. Two-way bicycle access can be maintained. Emergency vehicles can drive around partial closure with care. 	<ul style="list-style-type: none"> Reduces access for residents. Compliance with semi-diverters is not 100%. May increase trip length. 	<ul style="list-style-type: none"> Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$10,000 to \$20,000 each side of intersection</p>

Obstruction

Measure	Definition/Application	Advantages	Disadvantages	Special Considerations
 <p>Cul-De-Sac/Street Closure</p>	<p>Street closed to motor vehicles at the end of a block using planters, bollards, barriers, etc.</p> <ul style="list-style-type: none"> Traffic reduction Speed reduction 	<ul style="list-style-type: none"> Eliminates through traffic. Improves safety for all street users. Pedestrian and bicycle access maintained. 	<ul style="list-style-type: none"> Reduces emergency vehicle access. Reduces access to properties for residents. May increase trip lengths. May increase volumes on other streets. 	<ul style="list-style-type: none"> Emergency vehicle access Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$15,000 to \$25,000</p>
 <p>Mid-Block Street Closure</p>	<p>Street closed to motor vehicles mid-block using planters, bollards, barriers, etc.</p> <ul style="list-style-type: none"> Traffic reduction Speed reduction 	<ul style="list-style-type: none"> Eliminates through traffic. Improves safety for all street users. Pedestrian and bicycle access maintained. 	<ul style="list-style-type: none"> Reduces emergency vehicle access. Reduces access to properties for residents. May increase trip lengths. May increase volumes on other streets. 	<ul style="list-style-type: none"> Emergency vehicle access Lighting Signage Irrigation and maintenance of landscaping <p>Estimated Cost Range = \$15,000 to \$25,000</p>
 <p>One-Way Street</p>	<p>Street upon which motor vehicles may operate in just one direction.</p> <ul style="list-style-type: none"> Possible traffic reduction 	<ul style="list-style-type: none"> Increased safety due to lack of opposing traffic. Can be used to open up more resident parking. Maintains reasonable access for emergency vehicles. Can discourage through traffic. 	<ul style="list-style-type: none"> Can lead to increased vehicle speeds. May increase trip lengths. May increase volumes on other streets. Initial safety concerns as drivers adjust. Alternative route must exist. 	<ul style="list-style-type: none"> Signage <p>Estimated Cost Range = \$2,000 to \$3,000</p>
 <p>Imploding/Exploding One-Way Street Intersections</p>	<p>Intersection at which opposing legs carry one-way traffic in different directions.</p> <ul style="list-style-type: none"> Traffic reduction 	<ul style="list-style-type: none"> Increased safety due to lack of opposing traffic. Maintains reasonable access for emergency vehicles. Interrupts the flow of through traffic. 	<ul style="list-style-type: none"> May increase trip lengths. May increase volumes on other streets. Initial safety concerns as drivers adjust. Alternative route must exist. 	<ul style="list-style-type: none"> Signage <p>Estimated Cost Range = \$3,000 to \$5,000</p>